ERL sub-Panel Kick-Off Meeting

June 9, 2021

Andrew Hutton

Why Are We Here?

- The European Lab Director's Group (LDG) established a Panel to evaluate ERLs, as one of five technologies to be studied
  - The other four are high field magnets, SRF, plasma acceleration and muon colliders
- While the Panel was collecting information, an ERL concept was put forward to build the ILC as an energy recovery twin collider, termed ERLC, with the prospect of a large increase of the e^+e^- instantaneous luminosity as compared to the ILC
- This caused the formation, in agreement with the LDG, of a sub-Panel to evaluate the prospects (primarily luminosity), involved R&D, and the schedule and cost consequences for the ERLC
- The concept to configure the FCC-ee as a high luminosity circular energy recovery collider, called CERC, should also be evaluated with the same criteria
- The sub-Panel should document its findings in an Appendix to the ERL baseline paper, which will be published in early fall 2021

Who Are We?

- The sub-Panel Members:
  - Chris Adolphsen (SLAC)
  - Reinhard Brinkmann (DESY)
  - Oliver Brüning (CERN)
  - Andrew Hutton (Jefferson Lab) - Chairman
  - Sergei Nagaitsev (Fermilab)
  - Max Klein (Liverpool)
  - Peter Williams (STFC)
  - Akira Yamamoto (KEK)
  - Kaoru Yokoya (KEK)
  - Frank Zimmermann (CERN)

Charter

- Goal: Evaluate two new concepts for high energy e^+e^- Colliders:
  - V. Litvinenko, T. Roser, M. Chamizo-Llatas, https://doi.org/10.1016/j.physletb.2020.135394
  - V. Telnov, https://arxiv.org/pdf/2105.11015.pdf
- The sub-Panel should evaluate the technical and financial implications of the two concepts compared to the FCC-ee and ILC projects
- What are the technical advances, specifically in luminosity?
  - Luminosity is the driver for the User interest, but polarization, reliability and energy upgrade potential are also important
- What are the technical obstacles requiring R&D?
  - These are the problem areas
- What would be time early for implementation?
  - Important question for ILC, less so for FCC-ee
- What is the rough cost implication (to about 10%)?
  - Cost effectiveness and absolute cost are both important

Charter - Continued

Deliverable:

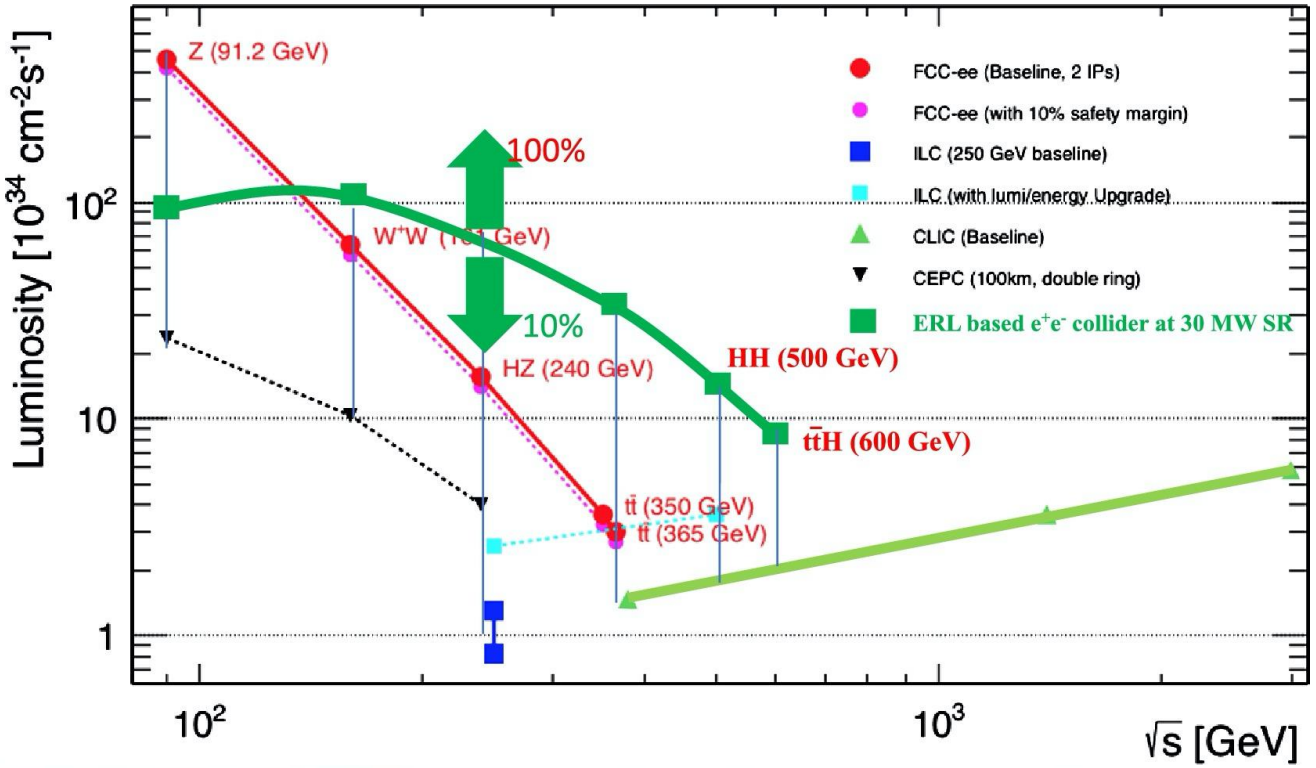
- A short report (~20 pages) detailing the conclusions of the evaluation, which should be agreed and supported by the entire sub-Panel and published as an Appendix to the full Panel report.

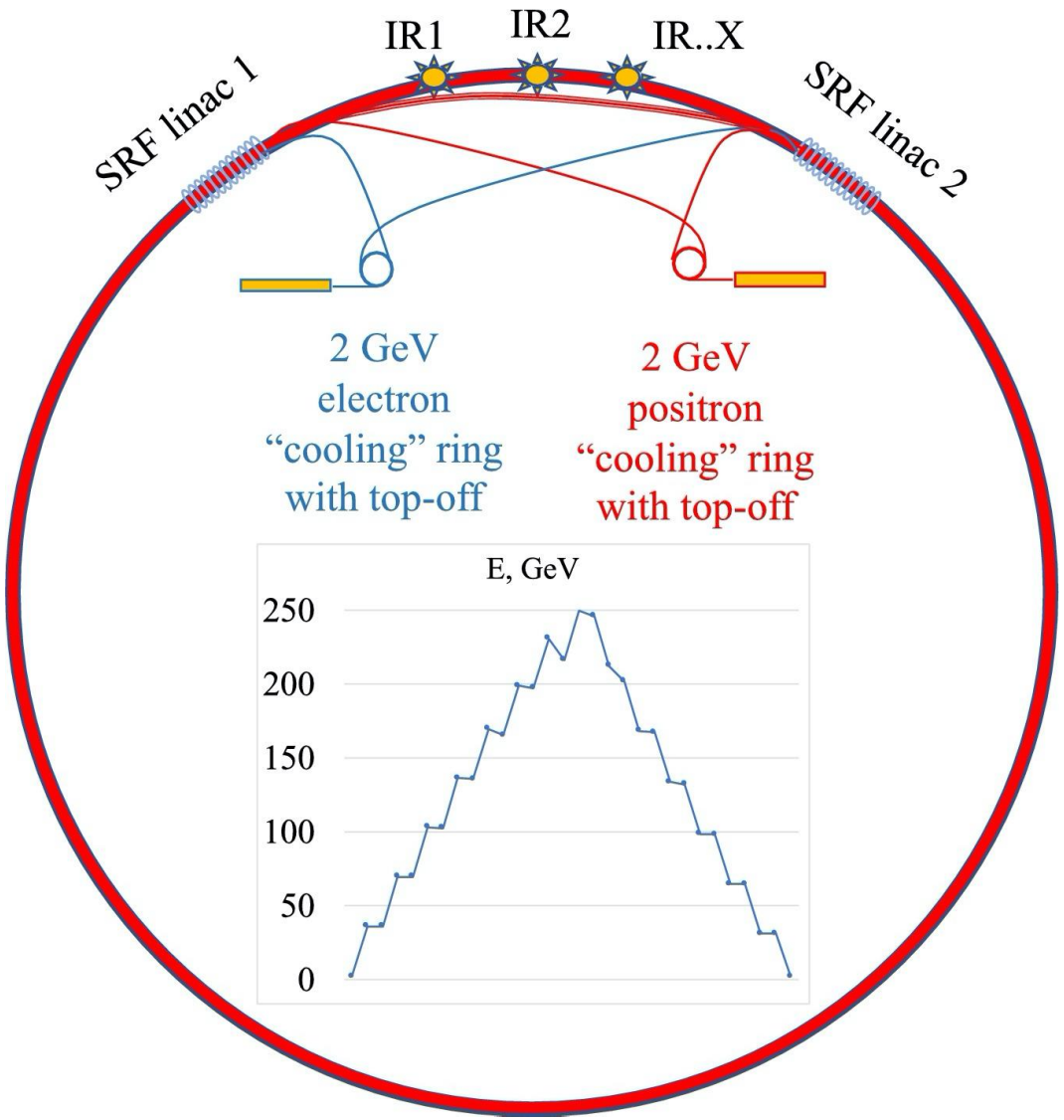
Methodology:

- We will have a short kick-off meeting mid-June, with initial discussion of the two projects
- There will be one 90 minute meeting on each concept: 1 hour for a presentation, 30 minutes for questions, followed by a second meeting of 1 hour; 30 minutes Q&A with the proponents and 30 minutes with just the panel. Written questions should be sent before the meetings to enable the protagonists to respond. I would like to receive your written opinions after each meeting
- I will collate the opinions and we will end with a meeting to finalize our conclusions

Circular Energy Recovery Collider – CERC

- Concept based on a 4-pass ERL with 16 separate beamlines
- Particles are recycled as well as energy
- Luminosity estimated to be ~ 10^{36} $cm^{-2}s^{-1}$





CERC – Items for Study –Self-Identified in Paper

- "There are a number of important design challenges for our proposed ERL-based collider, including but not limited to the following:"
  - I. Transport beamline lattice preserving a small vertical emittance;
  - II. Using small gap magnets to reduce power consumption of these beamlines;
  - III. Spreaders and combiners to propagate beams through the SRF linacs;
  - IV. High-order mode (HOM) damping of the SRF cavities to avoid transverse beam-breakup instability (TBBU):
  - V. Absolute beam energy measuring systems with accuracy (similar to that implemented for CEBAF) at IRs;
  - VI. Attaining a high degree of longitudinal polarization of colliding beams;
  - VII. High repetition rate ejection and injection kickers for 2 GeV damping rings;
  - VIII. Compressing and de-compressing electron and positron bunches to match energy acceptance of the 2 GeV damping rings
- We should evaluate these items and add any other items that you think we need to consider
  - The most important is the credibility of the luminosity estimate

Maria Chamizo

Director of the Office of Project Planning and Oversight for Detector Projects of Brookhaven National Laboratory (US). She is member of the Nuclear and Particle Physics Directorate and member of advisory committees to define the strategy of the laboratory that is at present operating the US most powerful heavy ion collider. Maria has a PhD in High Energy Physics by the Universidad Autónoma de Madrid (1997), is qualified as Professor in Particle Physics by the Ministère de l'Enseignement Supérieur et de la Recherche (Francia, 2012), and was Fermilab (Fermi National Laboratory, US) Distinguished Researcher in 2014. Her research work has focused in the study of the basic constituents of matter using High Energy Collisions in the world´s most powerful accelerators.

She was responsible of the operation of the CMS detector at the Large Hadron Collider at CERN (European Organization for Nuclear Research) during the first run of the accelerator, that resulted in the discovery of the Higgs boson for which F. Englert and P.W. Higgs received the Noble Prize in 2013. She was member of the management board and executive board of the CMS experiment in 2012-2013.

Maria was the Spanish Delegate at the European Particle Physics Communication Network since its creation until 2015 and she has been member of several scientific committees in High Energy and Heavy Ion Physics.